

LISTING OF THE CLAIMS

1 Claim 1 (original): A device for on-line correction of patient motion in three-
2 dimensional positron emission tomography wherein a positron emission tomograph
3 device is used to collect coincidence event and position data, said device comprising:

4 a first digital pipeline latch for receiving said data collected by said positron
5 emission tomograph device;

6 a plurality of multipliers disposed in parallel, each of said plurality of
7 multipliers for receiving and multiplying a portion of said data to generate a product
8 simultaneous with each other of said plurality of multipliers;

9 a second digital pipeline latch for simultaneously receiving said product from
10 each of said plurality of multipliers;

11 a plurality of adders disposed in parallel, each of said plurality of adders for
12 receiving and summing a plurality of said product from said plurality of multipliers;
13 and

14 a third digital pipeline latch for receiving data from said plurality of adders, said
15 data being representative of a pair of transformed coordinate points from a primary
16 coordinate system to a secondary coordinate system;

17 whereby as said data is input to said first digital pipeline latch, said product of
18 said data from an immediately previous said event is input to said second digital
19 pipeline latch and completely transformed data from a second immediately previous
20 said data is input to said third digital pipeline latch, and whereby said event data is
21 transformed from said primary coordinate system to said secondary coordinate system
22 in real time.

1 Claim 2 (cancelled)

1 Claim 3 (previously amended): The device of Claim 11 wherein said plurality
2 of multipliers includes eighteen said multipliers, one each being provided to multiply
3 one ordinate of one of said detector pair in said primary coordinate system with one
4 said direction cosine as set forth in equations (1) through (6), and wherein said
5 plurality of adders includes six said adders, one each being provided to sum three said
6 products from said plurality of multipliers and one said translational offset as set forth

7 in equations (1) through (6), whereby said transformed coordinates (x', y', z') for each
8 of said pair of detectors are acquired.

1 Claim 4 (original): A method for on-line correction of patient motion in three-
2 dimensional positron emission tomography wherein a positron emission tomograph
3 device is used to collect coincidence event data, said method comprising the steps of:

4 a) collecting data relative to a scan;

5 b) delivering said scan data to a processor having a first digital pipeline
6 latch, a plurality of multipliers, a second digital pipeline latch, a plurality of adders,
7 and a third digital pipeline latch;

8 c) multiplying selected groups of said data in said plurality of multipliers to
9 simultaneously acquire a plurality products;

10 d) delivering said plurality of products to said second digital pipeline latch;

11 e) summing a selected group of said plurality of products in said plurality of
12 adders to acquire a plurality of sums representative of transformed coordinates from a
13 primary coordinate system to a secondary coordinate system;

14 f) delivering said plurality of sums to said third digital pipeline latch.

1 Claim 5 (cancelled)

1 Claim 6 (previously amended): The method of Claim 12 wherein said plurality
2 of multipliers includes eighteen said multipliers, one each being provided to multiply
3 one ordinate of one of said detector pair in said primary coordinate system with one
4 said direction cosine as set forth in equations (1) through (6), and wherein said
5 plurality of adders includes six said adders, one each being provided to sum three said
6 products from said plurality of multipliers and one said translational offset as set forth
7 in equations (1) through (6), whereby said transformed coordinates (x', y', z') for each
8 of said pair of detectors are acquired.

1 Claim 7 (cancelled)

1 Claim 8 (cancelled)

1 Claim 9 (currently amended): The method of Claim 13, before said step of d)
2 multiplying selected groups of said data in said plurality of multipliers, and after said

3 step of c) normalizing said data, further comprising the step of histogramming said
4 data.

1 Claim 10 (cancelled)

1 Claim 11 (previously presented): A device for on-line correction of patient
2 motion in three-dimensional positron emission tomography wherein a positron
3 emission tomograph device is used to collect coincidence event and position data, said
4 device comprising:

5 a first digital pipeline latch for receiving said data collected by said positron
6 emission tomograph device;

7 a plurality of multipliers disposed in parallel, each of said plurality of
8 multipliers for receiving and multiplying a portion of said data to generate a product
9 simultaneous with each other of said plurality of multipliers;

10 a second digital pipeline latch for simultaneously receiving said product from
11 each of said plurality of multipliers;

12 a plurality of adders disposed in parallel, each of said plurality of adders for
13 receiving and summing a plurality of said product from said plurality of multipliers;
14 and

15 a third digital pipeline latch for receiving data from said plurality of adders, said
16 data being representative of a pair of transformed coordinate points from a primary
17 coordinate system to a secondary coordinate system;

18 wherein said plurality of multipliers and said plurality of adders are provided to
19 produce transformed coordinates from said primary coordinate system to said
20 secondary coordinate system for each of a pair of detectors using the equations:

21
$$x_a' = d_{xx} * x_a + d_{xy} * y_a + d_{xz} * z_a + X ; \quad (1)$$

22
$$y_a' = d_{yx} * x_a + d_{yy} * y_a + d_{yz} * z_a + Y ; \quad (2)$$

23
$$z_a' = d_{zx} * x_a + d_{zy} * y_a + d_{zz} * z_a + Z ; \quad (3)$$

24
$$x_b' = d_{xx} * x_b + d_{xy} * y_b + d_{xz} * z_b + X ; \quad (4)$$

25
$$y_b' = d_{yx} * x_b + d_{yy} * y_b + d_{yz} * z_b + Y ; \text{ and} \quad (5)$$

26
$$z_b' = d_{zx} * x_b + d_{zy} * y_b + d_{zz} * z_b + Z ; \quad (6)$$

27 where:

28 X, Y, and Z are translational offsets from a point (x, y, z) in said primary
29 coordinate system to a point (x', y', z') in said secondary coordinate
30 system;
31 d_{xx} , d_{xy} , and d_{xz} are direction cosines between the x-, y-, and z-axes and the x'
32 axis, respectively;
33 d_{yx} , d_{yy} , and d_{yz} are direction cosines between the x-, y-, and z-axes and the y'
34 axis, respectively;
35 d_{zx} , d_{zy} , and d_{zz} are direction cosines between the x-, y-, and z-axes and the z'
36 axis, respectively; and
37 a and b are two detectors in a detector pair;
38 whereby as said data is input to said first digital pipeline latch, said product of
39 said data from an immediately previous said event is input to said second digital
40 pipeline latch and completely transformed data from a second immediately previous
41 said data is input to said third digital pipeline latch, and whereby said event data is
42 transformed from said primary coordinate system to said secondary coordinate system
43 in real time.

1 Claim 12 (previously presented): A method for on-line correction of patient
2 motion in three-dimensional positron emission tomography wherein a positron
3 emission tomograph device is used to collect coincidence event data, said method
4 comprising the steps of:

- 5 a) collecting data relative to a scan;
- 6 b) delivering said scan data to a processor having a first digital pipeline
7 latch, a plurality of multipliers, a second digital pipeline latch, a plurality of adders,
8 and a third digital pipeline latch;
- 9 c) multiplying selected groups of said data in said plurality of multipliers to
10 simultaneously acquire a plurality products;
- 11 d) delivering said plurality of products to said second digital pipeline latch;
- 12 e) summing a selected group of said plurality of products in said plurality of
13 adders to acquire a plurality of sums representative of transformed coordinates from a
14 primary coordinate system to a secondary coordinate system, wherein said plurality of
15 multipliers and said plurality of adders are provided to produce transformed

coordinates from said primary coordinate system to said secondary coordinate system for each of a pair of detectors using the equations:

$$x_a' = d_{xx} * x_a + d_{xy} * y_a + d_{xz} * z_a + X ; \quad (1)$$

$$y_a' = d_{yx} * x_a + d_{yy} * y_a + d_{yz} * z_a + Y ; \quad (2)$$

$$z_a' = d_{zx} * x_a + d_{zy} * y_a + d_{zz} * z_a + Z ; \quad (3)$$

$$x_b' = d_{xx} * x_b + d_{xy} * y_b + d_{xz} * z_b + X ; \quad (4)$$

$$y_b' = d_{yx} * x_b + d_{yy} * y_b + d_{yz} * z_b + Y ; \text{ and } \quad (5)$$

$$z_b' = d_{zx} * x_b + d_{zy} * y_b + d_{zz} * z_b + Z ; \quad (6)$$

where:

X, Y, and Z are translational offsets from a point (x, y, z) in said primary coordinate system to a point (x', y', z') in said secondary coordinate system;

d_{xx} , d_{xy} , and d_{xz} are direction cosines between the x-, y-, and z-axes and the x' axis, respectively;

d_{yx} , d_{yy} , and d_{yz} are direction cosines between the x-, y-, and z-axes and the y' axis, respectively;

d_{zx} , d_{zy} , and d_{zz} are direction cosines between the x-, y-, and z-axes and the z' axis, respectively; and

a and b are two detectors in a detector pair;

f) delivering said plurality of sums to said third digital pipeline latch.

Claim 13 (previously presented): A method for on-line correction of patient motion in three-dimensional positron emission tomography wherein a positron emission tomograph device is used to collect coincidence event data, said method comprising the steps of:

a) collecting data relative to a scan;

b) delivering said scan data to a processor having a first digital pipeline latch, a plurality of multipliers, a second digital pipeline latch, a plurality of adders, and a third digital pipeline latch;

c) normalizing said data;

d) multiplying selected groups of said data in said plurality of multipliers to simultaneously acquire a plurality products;

e) delivering said plurality of products to said second digital pipeline latch;

13 f) summing a selected group of said plurality of products in said plurality of
14 adders to acquire a plurality of sums representative of transformed coordinates from a
15 primary coordinate system to a secondary coordinate system; and
16 g) delivering said plurality of sums to said third digital pipeline latch.

1 Claim 14 (new): A method for on-line correction of patient motion in three-
2 dimensional positron emission tomography wherein a positron emission tomograph
3 device is used to collect coincidence event data, said method comprising the steps of:

4 a) collecting data relative to a scan;
5 b) delivering said scan data to a processor having a first digital pipeline
6 latch, a plurality of multipliers, a second digital pipeline latch, a plurality of adders,
7 and a third digital pipeline latch;
8 c) normalizing said data comprising the steps of:
9 1) inputting event data into a first normalizing pipeline latch to
10 provide a transaxial geometric correction value for said event;
11 2) providing a geometric correction value for said event;
12 3) inputting said geometric correction value and information
13 regarding said event to a second normalizing pipeline latch;
14 4) providing a dead time correction value for said event; and
15 5) performing an integer multiply of said geometric correction value
16 and said dead time correction value;
17 d) multiplying selected groups of said data in said plurality of multipliers to
18 simultaneously acquire a plurality products;
19 e) delivering said plurality of products to said second digital pipeline latch;
20 f) summing a selected group of said plurality of products in said plurality of
21 adders to acquire a plurality of sums representative of transformed coordinates from a
22 primary coordinate system to a secondary coordinate system; and
23 g) delivering said plurality of sums to said third digital pipeline latch.

1 Claim 15 (new): A method for on-line correction of patient motion in three-
2 dimensional positron emission tomography wherein a positron emission tomograph
3 device is used to collect coincidence event data, said method comprising the steps of:

4 a) collecting data relative to a scan;

5 b) delivering said scan data to a processor having a first digital pipeline
6 latch, a plurality of multipliers, a second digital pipeline latch, a plurality of adders,
7 and a third digital pipeline latch;
8 c) normalizing said data;
9 d) histogramming said data including the steps of:
10 1) reading from a memory a current bin value indexed by a bin
11 address;
12 2) applying said bin value produced by said memory together with a
13 normalization value for said current bin to an adder; and
14 3) writing an output of said adder to said current bin
15 d) multiplying selected groups of said data in said plurality of multipliers to
16 simultaneously acquire a plurality products;
17 e) delivering said plurality of products to said second digital pipeline latch;
18 f) summing a selected group of said plurality of products in said plurality of
19 adders to acquire a plurality of sums representative of transformed coordinates from a
20 primary coordinate system to a secondary coordinate system; and
21 g) delivering said plurality of sums to said third digital pipeline latch.